

Evaluation of the development of professional competence in undergraduates: methodical aspects

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ABSTRACT

Bologna process puts in a high claim for the modern European education in terms of competency building approach. The control is conducted by the agencies which monitor learning activity level in higher education institutions. This paper presents the aspects of higher education within the conduction of competency building approach projects in Europe and Russia. We propose the technology which evaluates students' professional competence qualimetricly. The technology represents the evaluation algorithm at all levels of student training.

KEYWORDS

competence, vocational qualification, European Qualifications Framework, result of evaluation, evaluation indicators.

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Introduction

Each higher education institution faces the list of prioritized qualities which a graduating student must have for a successful job placement. Traditionally employers say that above all a young specialist must have the natural and competence potential and must have a good vocational training on the second-priority basis. Nowadays an employer needs not just a qualification which depends on certain knowledge, but competence which combines teamwork ability, proactivity, creativity, ability to use the knowledge in other fields. In response to labour force market, the real vocational qualification and competence have become the major criterion in graduating student's evaluation. Such qualities provide

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competitive ability and occupational mobility of a specialist (Redling, 2002).

To this end the competency building approach project is being carried out in Russia. This project is introduced in Federal State Educational Standards of higher vocational education in the third or even fourth generation (FSES HE) (Federal State Educational Standards; Coordination Council...). The standards describe the general data of a bachelor vocational career, the main goals for the occupation; they deal with employment functions and operations; they register skills and knowledge (which are essential for a bachelor) oriented to the creation of a multilevel education system, integration and educational internationalization within Bologna process (Zamyatin, 2012). FSES gives the following definitions: competence is the ability to make use of knowledge, skills and personal qualities for a successful work in different problematic professional and life situations; competence is the graduate's skill level of total competence, which reflects the readiness condition to use knowledge and skills and to be successful with the help of the formed competence. According to these definitions the notion of competence is much wider than the notion of knowledge and skills since it involves personality orientation (motivation, value system), its ability to overcome stereotypes, to feel the problems, to show perspicacity, mental flexibility, self-dependence, determination, volitional powers (Zamyatin, 2012).

Educational systems reforms in the Russian Federation have been proceeding for over 20 years. In this period of time they proceed with adoption of international experience, primarily European, with the aim of integrating in the global educational space and approaching international educational standards (Nazarova, 2014).

With the introduction of FSES HE colleges are solving the problem of transitioning to the new system of evaluating the level of graduate's preparation in the form of changing his competencies, levels of their development and, most importantly, searching the mechanisms of evaluating these levels. Unambiguous nature of the problem is related to certain controversies: presence of a college graduate's competence model and absence of a technology for evaluating these competencies; established "traditional" evaluating system, which is aimed at diagnosing knowledge, abilities and skills (KAS) and the need to evaluate graduate's competencies; the need in diagnostic methods of evaluating the quality of graduates' preparation and insufficient scientific-methodic supply of the

current, intermediate and final control. These controversies create the basis of the problem of finding scientific and methodic supply in evaluating professional competencies in college students. Unified mechanisms of competencies evaluation have not been developed yet. There is only a suggestion from the practical workers to make it easy, logical, and as little effort-consuming as possible, with minimal preparation of documentation.

Methodology

The connection between quantitative and qualitative evaluations of competences evaluation is created on the basis of traditionally established separation into two groups. Classifying or comparing evaluations are included in the category of qualitative evaluations, while metric evaluations are quantitative. Qualitative evaluations are always less precise in comparison with the quantitative ones due to the techniques and tools used for obtaining them. Because of this, for higher convenience qualitative evaluations are presented in the form of certain scores on the traditional five-point scale or in any other, which is chosen on the basis of expert agreements (Chelyshkova *et al.*, 2011).

The most objective metric indicators allow creating statistical models and comparing them with the samples. The simplest integral method of expert evaluations of the competence development level, addressed in our study, is the indicator of evaluating activity component, proposed by G.R. Garafutdinova and L.P. Soloshenko (Garafutdinova and Soloshenko, 2013).

Discussion

There are different evaluation models of professionalism level, both foreign and domestic (Standards and Guidelines..., 2008).

In 2009 Council of Europe developed the standards in the field of education and human resources training within the Strategic Program of Education and Teaching (ET-2020). The standards were developed for each type and level of education. Maintenance of higher education quality is being controlled by the Standing Committee on Higher Education and Research (HERSC). The process of integrating unified requirements and recommendations into the educational systems of national higher education structures is supervised by Bologna group (BFUG) and European Center for professional education development (CEDEFOP) (Nazarova, 2014).

These days all European countries have agencies which monitor learning activity level in higher education institutions. At present, in education there are three main groups of quality models that are fundamental to the quality guarantee system construction in higher education institution (Model, 2004). The first group is based on TQM paradigm (Total Quality Management) and correspondent standards of quality management ISO 9000-family. The second group is the systems which are marked by criterion of a quality improvement model. This is the quality model EFQM (European Foundation for Quality Management) and the model ENQA which is approved by "Standards and Guidelines for higher education quality guarantee in European area". Both models were worked out by European association of higher education quality guarantee. The third group is the quality improvement models. They have a more precise focus. To the group it's possible to refer to the following: metrics (BSC), methodology "6 Sigmas", engineering system, common evaluation model (CAF) etc.

Regulatory requirements to competence level are introduced in "International Competence Baseline" and used in many European countries (Standards and Guidelines, 2008); as for Russia this notion is correlated to the notion "qualification profile" (Baidenko, 2005). The list of knowledge, experience and personal attitude is presented in these requirements.

At the moment there are two European qualifications frameworks: qualifications framework for pan-European higher education and European qualifications framework for lifelong training.

Qualifications framework for pan-European higher education aims at providing lucidity and compatibility of national and sectoral systems of higher education in Bologna process participating countries: bachelor degree, master's degree and doctoral degree. It is based on the common understanding of the curriculum and demands for its results. This qualifications system provides a foundation for overcoming the boundaries between academic and vocational education which is implemented in most existing national qualifications systems. Amid this document, curriculum developers must make educational plans according to "approaches oriented to results" which involves the usage of notions: levels, level descriptors, qualification descriptor, learning outcomes as well as more objective evaluation of teaching loads in terms of credits. Qualifications framework for pan-European higher education was

accepted by 45 Bologna process participating countries (A Framework for Qualifications, 2005).

European qualifications framework for lifelong training was developed in discharge of Education Cabinet Council resolution (November, 2004) (2616th Council Meeting, 2004) and European council resolution (March, 2005) (Presidency Conclusions, 2005) for EU Member States. The framework is the common frame of axis for describing the learning outcomes in eight skill levels which exist in national systems and fields.

The recognition of the fact that it is the quality that must become the keystone in a new European higher education area is in the picture of a ENQA document “Standards and Guidelines for Quality Assurance in the European Higher Education Area”. It is supported by EUA, EURASHE and ESIB and it was approved on the summit of European Education Ministers in Bergen.

The evaluation of learning outcomes in competency terms (competency building approach), which correspond with the program profile, was developed and tried out as part of the project “Tuning Educational Structures in Europe”. One of the project innovations is the connection of learning outcomes, competencies and credit transfer system on the basis of a teaching loads calculation (ECTS Users’ Guide).

The publication of the successful script criterion is becoming the norm, namely the universal rules which deal with any script and were published in textbooks and claims in regard to learning outcomes results at different educational levels (Standards).

Eventually the Russian qualifications aspects must merge with the unified structure of European claims to higher education (EHEA).

Generally competencies do not form for each object separately, but they represent complex characteristics being formed in the process of module study from different courses of study. It is very important for a student to be able to solve vital problems not only prospectively, but also within the training in higher education institutions. They include handling the problems of personal development and problems connected with successful self-positioning in a higher education institution. They are controlled both by the academic studies system and monitoring activities connected with accreditation (Putchkov and Tormasin, 2012).

It should be noted that the problem of measuring students’ competency level in Russia is not standardized properly. Methods and models of such

measuring are not formulated, and this certainly is a very important aspect for defining the quantitative level of students' acquisition of particular competencies (Berestneva, 2007; Kozlova *et al.*, 2010; Shalashova, 2009). New educational standards expect in a declarative way that each higher education institution must work out their own methodology for competency evaluation and diagnostic materials. One of the most discussed, disputable and unsettled problems is the result evaluation in learning activity, due to the fact that the society continuously changes the demands to educational results and due to the development of pedagogical, psychological and qualimetric sciences. The evaluation can be defined as the system process which aims at defining the degree of conformity of trainee achievements with the standard target result. This result offers validity, objectivity, availability and responsiveness and it intends to single out the levels and to define the value of an obtaining result.

The complexity of competencies evaluation consists in the fact that, usually, professional competencies have a complex structure because professional tasks are usually divided into sub-tasks. Therefore, each competence is characterized by a certain set of abilities, learning which allows mastering this type of activity. Consequently, by trying to evaluate the competencies, a teacher encounters the following difficulties: firstly, the same competence can be developed within various subjects, and therefore, evaluation will require interdisciplinary approach and "complex units of measure"; secondly, a number of competencies is related to personality characteristics and skills, which implies the use of psychological diagnostics in the evaluation process, which is not accounted for by the normative documents in our country; thirdly, success in a competence development is defined by the influence of multiple factors: education content, pedagogic process technological support, choice of a place to study, styles of interaction between teachers and students, quality of the control system in college, nature of internships, traineeships, etc.

In the European region approaches and mechanisms of students' competencies evaluation are slightly different.

In Netherlands graduates' competencies are evaluated only within special competence-oriented examinations. Each competence is outlined in a system of specified characteristics for the evaluation, a system of evaluated knowledge, abilities and skills, which belong to various fields: educational, personal, working and scientific fields. Each field is

represented by several competencies (2-3 but not more than 4). The evaluation mechanism is testing control.

In Germany graduates' competencies evaluation is videotaped and then the student's actual process of solving practical tasks is analyzed. Moreover, for each task there are grading scales, which help interpreting the results. Throughout all education increase in individual achievements in competencies development is being monitored.

In Great Britain competencies are measured by a portfolio, which is being collected by the students themselves. These materials list graduate's knowledge and abilities and states where (university, department), on which conditions (patterns of study, payment, benefits, grants) he learned them in the form of certain academic subjects (study courses, disciplines). Moreover, all abilities and skills stated by the graduate can be verified both during recruitment for a job and during the evaluation of coherence with the present position in the company.

Students' academic achievements are quantitative and qualitative characteristics of their acquisition of the main general-education program and professional and personal development. They have to reflect students' advancement towards the ultimate result of their professional training - professional and personal competence. The results of the educational process include not only the level of knowledge, abilities and skills, but also the acquired competencies, axiological attitudes, developed personal qualities, etc. Professional competencies are an integration of knowledge, abilities, experience and skills, obtained during learning the corresponding educational disciplines and interdisciplinary courses, as well as during educational and professional practice within a certain educational module.

Involvement in the professional activity depends on the activity subject's personality, professional preparation, experience and professionally significant qualities. On the other hand, it also depends on the characteristics of the object and field of activity, specifics of a certain profession and a certain type of professional activity, which define the content, orientation and time of learning, as well as tools and methods of professional training. Among various means of personality socialization, internships have a special place because, due to their specifics, they are tightly integrated in the social reality and acts as a connection between student's theoretical education and his prospective independent activity. Internships create the conditions for acquiring life experience, expanding student's social contacts and developing self-regulation skills. By

communicating with different people and participating in solving the occurring industrial problems, a student presents, develops and consolidates special abilities and valuable moral qualities. During the internships students directly acquire a certain system of norms, rules, social roles and values, which will further help them to actualize as competent specialists in their fields of knowledge (Mitroshin, 2012).

Currently, internship has to be considered not only as a tool for developing professional adaptation and skills, development of cognitive and creative activity in the prospective specialists, diagnosing their level of professional orientation and preparation, but also as a mean for developing professional competencies. Therefore, professional competence is a system of a specialist's intellectual, psychological, moral and activity (functional) competencies, which reflect the level of acquired knowledge, skills, abilities, informational saturation and other qualities in a specific field of professional activity. Currently developed system of internships does not fully correspond with developing students' creative activity and independence in mastering the professional activity. Students are not always aware of the connection between theoretical knowledge with the specific tasks, which they performed themselves during the internships, which makes the process of developing a specialist's professional competence significantly more difficult (Mitroshin, 2012).

In order to perform the monitoring of students' academic achievements successfully, we should use adequate methods of evaluation, on the one hand, and these methods have to be actualized with the educational process, on the other hand. The following traditional and modern methods of students' academic achievements evaluation can be used as the monitoring methods: survey, observation of the activity, testing, analysis of the educational activity results (essays, reports, etc.), study projects, reflective methods, authentic (e.g. portfolio) and formative methods of evaluation.

Pedagogic practice uses the techniques, which combine accumulating and formative evaluation. The essence of the formative evaluation is evaluating the activity process per se, i.e. "the evaluation of the level of correspondence of a student's real practical actions with the earlier established format". In order to conduct the formative evaluation, a teacher creates small tasks and tests, the conclusions of which are discussed and the results are saved in the score sheet and accumulated.

The monitoring of quality of training in the curriculum disciplines and the stimulation of students' methodic work both classroom-based and individual is carried out via the grade-rating system of the educational competencies evaluation. The diagnostics of a certain level of competencies development is the most difficult part of a research when developing and implementing the competency building approach. Methods and techniques of competencies evaluation can involve: theoretical tasks for individual work (composing reports, papers, structural abstracts, articles and presentations), tests, colloquiums, project activities, educational- and scientific researches, creative activities, the case-method, cases, a professional simulation, Delphi technique ("brainstorming"), master classes, education and work experience internship, pass-fail exams, exams, a personal portfolio.

Defining a competence as a skill to use knowledge, abilities and personal qualities for successful activity in a certain field implies a cognitive basis of a competence (knowledge and comprehension), an activity (knowledge how to act) and personality (knowledge how to be) bases. Because of this, there the following components in pedagogic college students' academic achievements:

- cognitive (system of professional knowledge, which a student acquires during his education);
- activity (abilities and skills for performing professional activity);
- motivational-axiological (motivational readiness to present professional and personal competence, positive attitude towards the professional activity content and educational process and axiological orientations towards the pedagogic profession);
- integrative (acquired general-cultural and professional competencies).

Integrative component is not a mere sum of cognitive, activity and motivational-axiological components of students' educational activities; it represents a qualitative component of academic achievements, which requires a sufficient level of demonstration of the rest three components.

To evaluate students professional training some authors suggest methods and indicator units which reflect the level of competencies development and their individual components when studying different disciplines and which could be rather difficult in practice (Bochagov, 2010; Putchkov and Tormasin, 2012).

In this paper we focus on evaluation indicators of the competencies development level quantitatively. To our mind the most likely indicator for finding out the level of a student's professional competency is the

evaluation indicator of an activity component, which was suggested by G.R.Garafutdinova and L.P. Soloshenko (Garafutdinova and Soloshenko, 2013):

$$K = \frac{\sum_{i=1}^N n_i}{nN} = \frac{n_1 + n_2 + \dots + n_N}{nN} \quad (1)$$

where

K - recall factor of the formation of professional-mathematical skills (competencies);

n_i - quantity of technological operations completed correctly;

n - quantity of operations which are to be completed;

N - quantity of rated engineering and mathematical projects accomplish by a student.

The evaluation of assignments for submission (tests) in a discipline can be made using the formula of information digestion mid-coefficient:

$$K_{med} = \frac{f_1 \dots n_1}{F_{max}} \cdot 100\% \quad (2)$$

where

F_{max} - highest possible grade point for test execution;

f_i - grade points scored in a group generally.

Stability factor of information digestion:

$$K_{med} = \frac{f_i}{F_{max}} \cdot 100\% \quad (3)$$

To establish the level of personal components' formation (cognitive, axiological etc.) questionnaires with possible answers "yes", "as soon as not", "can't say", "no" are often used. These questionnaires adapt with regard to competencies' disarticulated structural components. In this case the recall factor of the formation level is computed:

$$K_{ie} = \frac{a(+2) + b(+1) + c(0) + d(-1) + e(-2)}{H} \quad (4)$$

where

K_{ie} - self-evaluation recall factor;

a - number of answers with solid positive evaluation “yes” (+2 grade points);

b - with positive evaluation “as soon as not” (+1 grade point);

c - with doubtful definite evaluation “can’t say” (0 grade points);

d - with almost negative evaluation “very unlikely” (-1 grade point);

e - with solid negative evaluation “no” (-2 grade points);

H - number of diagnostic indicator: knowledge and skills, personal properties and qualities.

The cognitive basis for all the competencies are knowledge and skills. But the correlating nature of principal didactic components changes: competency building approach puts forward demands to subject knowledge to skills and practical requirements based on axiological aspects. In this regard for measuring the cognitive component it is more efficient to employ traditional methods of control both oral (interview, colloquium, pass-fail exam) and written (tests, written tests, structural abstracts, graphical-calculation works, educational and research reports on practice, reports on academic research work). It is always possible to normalize testing to 100 grades measuring and to measure the knowledge level as a result of a written test using the formula (3). This corresponds to 100 grades too.

In case of design-and-engineering competency it is possible to measure the activity component with innovative evaluative means: module-rating system, the case method, portfolio, cooperative method development, project method, professional simulation, Delphi technique.

For praxeological, axiological and reflexive components, it is possible to use questionnaires, expert evaluation methods. In this case we can apply the formula (4).

Therefore the overall quantitative index can be submitted in the form:

$$K_{comp.} = C_1 K_{cogn.} + C_2 K_{activ.} + C_3 K_{prax.} + C_4 K_{axiol.} + C_5 K_{reflex.} \quad (5)$$

where the weight numbers of each component C_1 , C_2 , C_3 , C_4 , C_5 are defined separately by expertise for each competency.

For example, for design-and-engineering competency it is possible to set the following weight numbers: $C_1 = 0,3$, $C_2 = 0,3$, $C_3 = 0,2$, $C_4 = 0,1$, $C_5 = 0,1$.

Hence: $K_{design} = 0,3 \cdot K_{cogn.} + 0,3 \cdot K_{activ.} + 0,2 \cdot K_{prax.} + 0,1 \cdot K_{axiol.} + 0,1 \cdot K_{reflex.}$

To define the competencies formation level we can use the following universally applicable grading scale:

$K_{comp.} < 50$ - professional adaptive level;

$50 \leq K_{comp.} < 70$ - professional technology level;

$K_{comp.} \geq 70$ - professional research level.

Conclusion. It is possible to apply the technology of qualimetric evaluation of students' professional competence not only for professional, but also for common cultural competencies. Therefore it is necessary to change the competencies' blend composition and the weight numbers of the overall quantitative index.

Therefore, the proposed technology of qualimetric evaluation of students' professional competence represents the algorithm of coherent complete evaluation process (saving traditional principles and renovating the structure and process structuring) and allows presenting the results of vocational training at all levels in an objective, valid and valuable way (preliminary, current, transitional and overall evaluation).

Competence approach implementation in colleges is accompanied by the fact that the evaluation of the educational process results, presented in the language of competencies, becomes more variant, complex and effort-consuming. Evaluation procedures of students' academic achievements monitoring are integrated in the educational process and are already not just a mean of control. Modern educational process cannot be mono-evaluated because, on the one hand, it implies the evaluation of student's various achievements, and on the other hand, the evaluation cannot be performed only by a teacher; student group and a student himself are involved in the evaluation process.

A significant problem in monitoring students' competence development is the development and integration in practice of the pedagogic control of the specific and adequate criteria and characteristics, because the criteria system has to provide a sufficient level of objectivity. Competence approach in students' education needs the development of

the constructive methodic content, including a universal system of evaluating competencies and their integration. Type and ways of integration depend on the direction of training and have a number of invariants of the integration technology and its efficiency.

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